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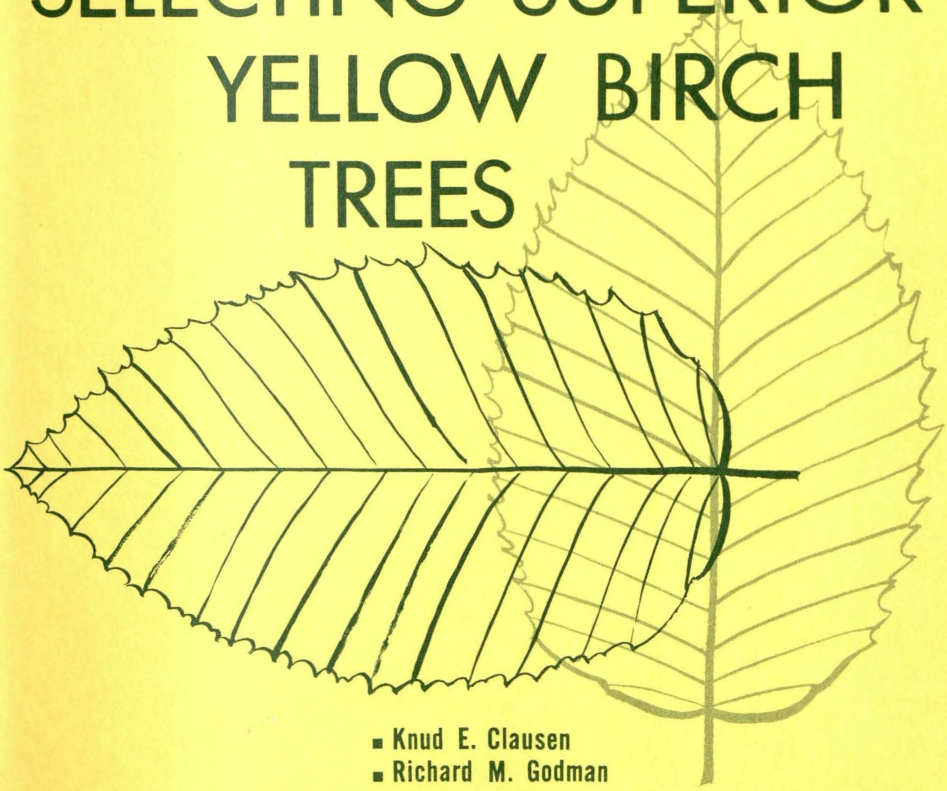
SELECTING SUPERIOR YELLOW BIRCH TREES



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Selecting Superior Yellow Birch Trees
A Preliminary Guide

Knud E. Clausen and Richard M. Godman

THE NEED FOR THIS GUIDE

Most tree improvement programs have been primarily concerned with the fast-growing, highly productive softwoods. However, since hardwoods are well adapted to the sites they now occupy on about half of the commercial forest land in the United States and support an increasingly important segment of the forest industry, genetic improvement of hardwoods is important also. Several species have as good a growth potential as many softwoods, and high-quality hardwoods probably exceed most softwoods in value per acre. For these high-value hardwoods the emphasis should be on tree quality rather than on faster growth and higher yields.

Yellow birch (*Betula alleghaniensis* Britt.), a valuable component of the northern hardwoods, produces heavy, hard, and strong wood which machines well and takes a beautiful finish. High-grade sawlogs, and veneer logs in particular, command high prices, but the supply of high-quality logs is decreasing rapidly. To satisfy future demand for quality products, we must develop improved planting stock and learn how to establish and manage yellow birch plantations.

The first step in a tree improvement program is to locate the best trees available. These superior trees are phenotypic selections and not of proven genetic worth. Next the selected trees are tested for their genotypic superiority — that is, their ability to transmit the desired characteristics to their progeny. During this phase of the program, we learn which characteristics are under strong genetic control. Finally, the superior genotypes are screened out and interbred, naturally or artificially, to produce genetically improved seeds or seedlings.

Only the selection phase is considered here. Rudolf's selection guide for Lake States trees did not include yellow birch.[1] Pitcher and Dorn gave criteria for several hardwoods, including yellow birch, but did not stress the quality characteristics.[2] This publication provides more detailed information on characteristics to look for in selecting superior yellow birch trees.

WHERE TO LOOK

The search for superior yellow birch trees should start in the best stands available. Since variation between stands is a product of both heredity and environment, selection should be relative to the best trees in a given area rather than to absolute numerical standards. If at all possible, selections should be made in stands where comparison trees are available. Only in special cases should isolated trees growing either among other species or in the open be selected.

Selections are easier to make in even-aged stands, but these are usually in the younger age classes. The age of the superior tree candidates should preferably be between 35 and 125 years. Trees younger than 35 years may not yet have had a chance to show their full potential, and old trees are difficult to propagate vegetatively. These age limits are not absolute, however, and outstanding trees younger than 35 or older than 125 years should be reported.

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[1] *Rudolf, P. O. 1956. Guide for selecting superior forest trees and stands in the Lake States. U.S. Forest Serv. Lake States Forest Exp. Sta., Sta. Pap. 40, 32 pp., illus.*

[2] *Pitcher, J. A. and D. E. Dorn. 1967. A new form for reporting hardwood superior tree candidates. Fifth Central States Forest Tree Improvement Conf. Proc., Wooster, Ohio, October 1966, p. 7-12.*

WHAT TO LOOK FOR

General Considerations

Yellow birch superior tree candidates should be healthy and vigorous dominants. They should be free of cankers, die-back, and other evidence of disease or insect injury; absence of this kind of injury may indicate that the trees possess some degree of resistance to insects or disease. Although defoliating insects like the birch skeletonizer (*Bucculatrix canadensisella* Cham.) and the birch leaf miner (*Fenusa pusilla* Lep.) seldom kill the trees, they reduce growth. The infestations also weaken the trees and make them more susceptible to attacks by other insects (e.g., birch scale (*Xylococculus betulae* Perg.)) or diseases.

A superior tree should be an average seed producer. While seed production probably is less important than tree quality and growth rate in the initial screening of candidate trees, this characteristic cannot be ignored. It is important to select trees that appear to flower regularly. On the other hand, trees that flower very abundantly may be undesirable since the production of large seed crops usually results in some growth reduction. Because of the periodicity of seed years, fruitfulness cannot always be assessed when the tree is first selected but the tree should be checked for its seed production at a later date.

Characteristics Affecting Tree Quality

Stem Characteristics

Although the characteristics of the entire stem must be considered in making selections, the first two logs (33 feet) are most important since this part of the tree yields the most valuable products. (Figs. 1-3 on pages 3 to 5 illustrate good and poor stem and crown characteristics.)

The bole should be straight. The straighter the log, the less waste in peeling for veneer or sawing for lumber. Even small crooks are objectionable. There should be no lean or sweep, since these deviations lead to the formation of tension wood, which causes shearing in veneer and warping, checking, and cupping in sawn lumber. Sweep also results in volume losses. Furthermore, the veneer in each end of a log with sweep will be cut across the fibers, leading to a degrade in veneer quality. For these reasons, logs with sweep are scaled at less than actual volume. Trees with excessive butt flare should not be selected since there may be some cutting across fibers as there is in logs with sweep.

The stem must be round. Many yellow birch stems are not truly round in cross section but have one flat side. The cause of this is uncertain, but it may be related to conditions of the crown. There is very little waste in rotary-cutting a round veneer log. The ratio between the smallest diameter and the largest diameter at any given point along the stem can be used as an index of roundness. A perfectly round stem will give a ratio of 1.00, and selected trees should have a ratio as close to this figure as possible, preferably not less than 0.95. The trees should be checked for any "flat" areas high on the stem. These are undesirable, partly because they may be indicators of disease.

The bole should have very little taper. Although proper silvicultural treatments may provide some control of stem form (pruning, for example, tends to decrease the amount of taper),[3] their effects may be too small to be of practical importance. Trees tapering more than 2 inches in 16 feet should not be selected.

A superior yellow birch stem should have straight grain. Logs with spiral or other unusual grain patterns are difficult to process for veneer except by slicing; since most yellow birch veneer is rotary-cut, unusual grain patterns degrade log quality.

[3] *Larson, P. R. 1963. Stem form development of forest trees. Forest Sci. Monog. 5, 44 pp.*

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FIGURE 1. This tree is undesirable because it has a short bole, repeated forking, and acute branch angles.

Spiral grain, "wavy grain," and irregular grain patterns in general can usually be detected on the outside of the tree. Detection is easiest in trees with fairly smooth bark. For example, small "bumps" or undulations on the surface of the bark are indicators of so-called "wavy grain," one of the greatest problems in the veneer industry. Since much of the cutting is across the fibers, it raises rough spots which either shear or at best are exceedingly hard to finish. Buyers for veneer mills will usually refuse to buy otherwise perfect logs if they have this defect, which may be overlooked by or appear unimportant to the seller. As a general rule, selections should be made among smooth-barked trees where there is less chance of overlooking unusual grain patterns.

Another reason for avoiding rough-barked trees is that they may be infected with birch scale. This insect causes roughening of yellow birch bark, but is otherwise difficult to detect. Since the insect also spreads *Nectria* spores, birch scale may be more important than commonly realized. Smooth bark may thus indicate greater resistance to the insect.

Trees should not have defects such as seams, bark distortions, or bird peck. In processing veneer logs, open or overgrown seams cause loss of volume due to shearing, or because of the presence of stain or overgrown bark. In other types of logs, deep seams, particularly when associated with rot, will reduce the scaled volume. Seams are usually indicators of some internal stress in the wood or of partial healing of scars and sunscald injuries.

Bark distortions may indicate buried defects such as epicormic buds, knots, or other irregularities that are undesirable in veneer logs. Bird peck, caused by sapsuckers, results in staining of the wood or, in severe cases, in

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FIGURE 2. A desirable but not perfect tree. The stem is well-pruned, round, and with little taper, but it has small crooks in the second log. The crown has very good proportions (crown length is 25 percent of tree height and crown diam./d.b.h. is 20:1), excellent apical dominance, small branches, good branch angles, and good density. What appears to be a fork halfway up the tree is actually part of the stem of another tree.

ring shake.[4] Since the birds seem to prefer certain trees there may be heritable chemical differences between trees; therefore, trees with bird peck should not be selected.

Good self-pruning is a desirable trait; but it is generally difficult to see whether good pruning is due to heredity or to the microenvironment. The amount and type of competition, for example, definitely influences self-pruning. In a tree that has grown a long time in the open, self-pruning may indicate strong genetic control. Such a tree should be selected if it otherwise meets the criteria for a superior tree. In a stand, selection for self-pruning is much more difficult. Some trees retain one or more steep-angled branches low on the stem. Since such branches result in large knots, these trees should be avoided.

Forking is particularly undesirable. Low forks cause a serious volume loss of potentially high-quality wood. Forked trees also tend to break from wind and ice; this usually results in some loss of the crown and subsequent growth reduction, and provides entrance ports for fungi and other disease organisms. There is good evidence that forking is under strong genetic control in most forest tree species, and individuals with repeated forking should, therefore, be avoided. Trees with a fork in the first two logs should never be accepted.

[4] *Shigo, A. L. 1963. Ring shake associated with sapsucker injury. U.S. Forest Serv. Res. Pap. NE-8, 10 pp., illus. Northeast. Forest Exp. Sta., Upper Darby, Penn.*

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FIGURE 3. Two trees with good stem characteristics and poor crown characteristics. Both trees have straight and round boles but too long crowns (crown length is about 45 percent of tree height). The forked tree on the left has large branches, acute branch angles, and too broad a crown (crown diam./d.b.h. = 28:1) of average density. The tree on the right has small branches but acute branch angles, average crown width (crown diam./d.b.h.= 25:1), and good crown density.

Forks may be caused by frost damage to buds, ice and wind injury of buds and shoots, and other climatic factors. Absence of forking may thus indicate possible resistance to environmental hazards and a desirable genetic make-up of the tree.

A yellow birch tree with any of the following conditions should be considered as forked:

1. The smaller of two adjacent leaders is at least two-thirds the diameter of the larger one.
2. The angle between a branch and the main stem is less than 30 degrees.
3. The diameter of the main stem above the branch juncture is at least 25 percent smaller than the stem diameter below the juncture.

Crown Characteristics

Good apical dominance — a central stem to the top of the tree — is a highly desirable but uncommon characteristic in yellow birch, perhaps due to the indeterminate growth habit of the species. Because it is rare, a thorough search will be required to find trees with good apical dominance. Superior tree candidates should preferably maintain a central stem to three-fourths of their total height. Only trees with a central stem to at least half of the total tree height or 33 feet, whichever is greater, should be accepted.

Trees with small branch angles should not be selected. Trees with large branch angles appear to have less breakage from ice and snow than those with more acute angles. Branch angle also affects stem taper, natural pruning, and knot size. Steep-angled branches are often larger than wide-angled branches, they usually take a longer time to die and fall off, and they leave large knots which are grading defects in hardwood logs. Large knots, whether from natural or from artificial pruning, also take more time to heal over than small knots. Since branch angle appears to be under strong genetic control, selection for large branch angles should result in considerable improvement in this characteristic.

Branch angles seem to be more acute in yellow birch than in many other species. Observations indicate that most mature yellow birches have branch angles between 30 and 60 degrees. Angles between 60 and 90 degrees are apparently rare. Superior trees should have as large branch angles as possible, preferably 45 degrees or more; trees with branch angles of 30 degrees or less are unacceptable.

Branch diameter should be small. Branches of small diameter leave small knots, which heal over faster than larger knots. Small branches are also cheaper to remove than large branches. There may be a favorable relationship between branch diameter and branch angle in yellow birch: i.e., trees with small diameter branches also appear to have large branch angles. If these two branch characteristics should, in fact, turn out to be correlated with each other or even linked genetically, selection for them should lead to rapid improvement.

A sawlog-sized tree should have *no* branches within the first two logs. A branch in the live crown should preferably not exceed one-sixth the diameter of the main stem at the point of branching; one-fifth would be the upper limit acceptable. Thus, a tree with a branch larger than 2 inches in diameter at a point where the stem diameter is 10 inches would be rejected.

Characteristics Affecting Growth

Although the quality of the stem is the first concern, characteristics that influence spatial requirements, growth rate, and total wood production cannot be ignored. Age of the candidate tree is important because of the large variation in age among yellow birches of the same diameter. For example, trees 20 inches in d.b.h. growing in the same stand may vary in age from 100 to 235 years.[5] The selected tree should, therefore, be of the same age, or younger than, at least three other yellow birches of comparable height, diameter, and crown size. The comparison trees should be growing within a radius of about twice the height of the superior tree.

Crown size is an important characteristic in yellow birch due to its effect on growth rate and total growth. A tree with crown size below a certain limit will have a slow growth rate and may die of suppression. On the other hand, yellow birch crowns appear to respond well to release. Both the length and the width of the crown are important. Although a crowded tree may compensate for its narrow crown by increasing the length of the crown, the crown should have certain desirable proportions.

The length of the live crown should be approximately 35 to 40 percent of total tree height. The larger ratio would be acceptable for small trees, whereas larger trees should have a crown ratio of 35 percent and certainly not less than 25 percent. The length of the live crown should be measured to the level of the lowest leaf-bearing surface, not to the point of attachment of the lowest live branches. Measurements based on the origin of the lowest live branch will overestimate the active part of the crown. In measuring crown length, leaf-bearing epicormic branches should be ignored.

[5] *Unpublished information on file at the Institute of Forest Genetics, Rhinelander, Wis.*

The width of the crown is important since a narrow-crowned tree that is growing as well as a wide-crowned tree occupies much less growing space, thus allowing a larger number of trees per acre. There is, however, a limit to how narrow the crown can be and at the same time maintain the tree in good growth. Experience has shown that the average yellow birch has a ratio of crown diameter to d.b.h. of 25:1. This ratio tends to be somewhat larger in younger trees, but a superior tree candidate 8 inches or less in diameter should not have a ratio larger than 22:1. Trees of larger diameter should have a ratio of 20:1 or preferably 18:1 to qualify as superior trees. A selected tree should be able to maintain this ratio while under moderate to heavy competition. If the competition is severe the crown will usually be too small, and the tree may respond by developing epicormic branches, which are undesirable in quality trees. The presence of epicormic branches usually indicates undesirable crown characteristics.

Dense crowns should be favored. Experience has shown that dense crowns usually produce average or better than average tree growth; thin crowns are associated with slow growth (fig. 4). So far no practical method of measuring crown density in the field has been developed, but it is possible to distinguish between dense and thin crowns. When the trees are leafless, crowns with many small branches of lower orders appear dense when viewed against the sky while crowns with mostly first- and second-order branches appear loose and thin.

Growth rate is less important than tree quality, but a superior tree should show average or better than average growth. While slower grown logs are somewhat easier to cut, faster grown logs present no particular problems in veneer production. A tree with a fairly dense crown of the size recommended above and growing under moderate competition should have grown at least 2 inches in d.b.h. in either of the last two 10-year periods. Such trees will, generally speaking, appear vigorous. Observations suggest that the

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FIGURE 4. A dense crown (left) and a thin crown (right). The crown on the left has more male catkins than the one on the right, but its denser appearance is primarily due to the presence of more twigs of lower branch orders.

vigor of yellow birches 12 inches d.b.h. and above can be judged by the appearance of the bark. Fast-growing, vigorous trees tend to have fairly smooth or extensively peeling yellowish bark, while slow-growing trees usually have rough, dark bark broken into flat plates. For example, a smooth-barked 14-inch tree averaged 0.25 inch in diameter per year whereas an adjacent rough-barked tree only grew 0.10 inch per year.[6] It may therefore be wise to avoid rough-barked trees.

Unusual Characteristics

Occasionally one finds a single yellow birch tree growing and competing successfully in stands of almost pure sugar maple. These trees may have a special competitive ability which conceivably could be a characteristic under genetic control and thus worth selecting for. If such trees are of high quality and otherwise satisfy the criteria for superior trees they should be selected and recorded as having this special attribute.

While irregular grain patterns as a rule are undesirable, trees with figured woods such as "curly," "flame," and "wavy" grain may be used for specialty veneers or solid-wood furniture. Such trees should, therefore, be reported.

Trees with other unusual characteristics should also be noted and reported. Examples are trees with unusual bark, branching habit, leaves, or fruits, and trees with especially early or late budbreak, flowering, fall coloration, or leaf fall. Most of the unusual characteristics will probably be of little or no practical value but may be useful in inheritance studies.

SUMMING UP

Procedures to follow and characteristics to consider in selecting superior yellow birch trees can be summarized as follows:

1. Locate the best 35- to 125-year-old stands in your area.

2. Look for dominant trees free of diseases and insects and, if possible, with good seed production.

3 Make the first selection on the basis of tree quality. Consider these stem and crown characteristics:

a. The stem should be straight and round, with little taper, and have straight grain and good self-pruning. It should have no forks or defects such as seams, bark distortions, or bird peck.

b. The crown should have good apical dominance. The branch angle should be as large as possible and the branch diameter as small as possible.

4. When trees of high quality have been selected, compare each superior tree candidate with three comparison trees within a radius of about twice the height of the selected tree. The following traits primarily affecting growth should be considered:

a. The selected tree should be of the same age, or younger than, the comparison trees.

b. The length of the live crown (measured to the level of the lowest leaf-bearing surface) should be 40 percent or less of total tree height in

[6] *Unpublished information on file at the Institute of Forest Genetics, Rhinelander, Wis.*

younger trees and between 35 and 25 percent in older trees.

c. The ratio of crown diameter/d.b.h. should not exceed 22:1 in trees 8 inches or less in d.b.h. and should range from 20:1 to 18:1 in larger trees. Trees with epicormic branches should be avoided.

d. Only trees with average to good crown density should be selected.

e. A superior tree should have average or better than average growth rate and should have grown at least 2 inches in d.b.h. in either of the last two 10-year periods. Smooth, yellow bark may indicate good tree vigor.

5. Give special consideration to trees competing successfully in sugar maple stands, and report trees with figured wood or other unusual characteristics.

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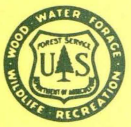

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